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CURRENT LITERATURE

BOOK REVIEWS

The origin of a land flora

Under this title Professor BOWER has written a volume¹ which must be regarded as the culmination of his important studies during the last twenty years. It is a formal and amplified statement of the views advanced in his series of five papers entitled "Studies in the morphology of spore-producing members," published between 1894 and 1903.

The scope of the volume is very broad and its spirit is admirable. The author recognizes that his thesis is not proved; that in the very nature of the case it never can be; and that there are many possible alternatives. However, he presents so strong a case that the truth of the theory would not come to anyone as a surprise. Naturally the book is speculative, and the author's frequent insistence that this is the case should be respected by those who follow its doctrine. The human mind seems to be so constituted that when a view is distinctly formulated it thereby seems to gain additional proof.

There is a strong tincture of teleology at every turn, the elimination of which would have strengthened the discussion. This gives it a flavor of unreal "other-worldliness" that is becoming unscientific. That a certain structure would be useful to a plant and therefore it grows, is hardly acceptable as an explanation of origins.

The thesis of the volume is the origin of the sporophyte as an antithetic generation, which has become fixed and amplified by the invasion of the land. In developing this doctrine, the author presents first a statement of the working hypothesis (pp. 254), then a detailed statement of facts (pp. 403), and finally the general comparisons and conclusions (pp. 60). In a brief review it is impossible to present the suggestions that fill these three parts. The second part—the statement of facts—is wisely separated from the other two, and in this form it represents an admirable treatment of the morphology of bryophytes and pteridophytes, especially the latter. Much new material is included here, and especially helpful is the massing of the morphological, anatomical, and paleobotanical evidence. These three points of view are too often kept separate, when they should serve as checks upon one another.

The two theoretical parts also contain much more detail than can be presented. However, the broad outlines of the working hypothesis and some of the more important conclusions may be indicated.

¹ BOWER, F. O., *The origin of a land flora: a theory based upon the facts of alternation*. 8vo. pp. xii + 727. *figs.* 361. London: Macmillan and Co. 1908. \$5.50.

Running throughout the hypothesis is the assumption that the most critical and hence controlling fact in the life of any organism is the relation existing between environment and fertilization. Perhaps the most fundamental conception is that the "Archegoniatae" are amphibious. (It may not be out of place here to suggest that the group name "Archegoniatae" has about outlived its usefulness. To associate the widely separated bryophytes and pteridophytes in this way, and to include or exclude part of the gymnosperms, is a grouping too unnatural and misleading to be continued.) That the gametophyte of "Archegoniatae" is amphibious means that it is just as aquatic as an alga, and shows this in its delicate structure, lack of intercellular spaces, lack of a water-conducting system, and the possibility of fertilization only in the presence of water. "The gametophyte proclaims its ultimate dependence on external fluid water as thoroughly as an alga." On the other hand, the sporophyte is characteristically an aerial body, with its more robust habit, "ventilating" system, vascular strands, and spores adapted for dryness.

Attention is called to the fact that the "Archegoniatae" retain with remarkable pertinacity this "awkward and embarrassing" method of fertilization; but that with the advent of the seed plants this becomes modified, and the higher seed plants at last become completely terrestrial.

A general outline of the steps by which the sporophyte was established and amplified as a terrestrial structure may be stated as follows: The gametophyte was the previously existing phase, and the initial step in the appearance of the sporophyte was the "post-sexual divisions, giving rise to a plurality of germs," such as is observed in the life-histories of certain green algae. In plants exposed to changing conditions of moisture and drought the fixing of such a generation would be assured, according to the following logic: external water would be occasional rather than constant; hence the sexual act would be occasional; hence there would be less dependence upon the sexual act for multiplying individuals; hence a "premium would be put upon" the other method of propagation suitable for drier conditions. Thus the sporophyte is to be recognized as a body originating as an adaptation to terrestrial life.

In amplifying the sporophyte, it is assumed that the first and also the final office of the sporophyte is to produce spores, and that the larger the number of spores (in homosporous forms) the better the chance of survival; therefore the increase in number of spores is "encouraged." But to protect spores when young and to nourish them during development presupposes some vegetative system.

The process for developing this vegetative system is the familiar theory of progressive sterilization, so well traced by the author among bryophytes. Among bryophytes, however, there are certain limits imposed by mechanical and physiological conditions; while among vascular plants there is greater freedom for progress, chiefly by the segregation of the sporogenous tissue into distinct sporangia and the formation of "appendicular organs." As a result of this progressive sterilization and organization of vegetative tissues, the fertile tissue appears later and

later in ontogeny, until what was first in phylogeny comes to be last in ontogeny. This disposition of the recapitulation theory appears in various places throughout the volume, and it is evident that the author regards it as reliable only within certain limits, when it agrees with other evidence.

From among the general conclusions the following may be selected as of most general interest. The author concludes that no definite algal form now living can be held to have been a direct progenitor of any known archegoniate type; but that certain algae suggest in their post-sexual phase how the initiation of the sporophyte may have occurred. Also the liverworts and mosses may be held to be "blind branches of descent;" but they illustrate changes that suggest the origin of sterile tissues from those potentially fertile, and the final establishment of a self-nourishing system in the sporophyte.

The gametophyte of early pteridophytes was probably a relatively massive green structure, with deeply sunk sexual organs; and the sporophyte was the strobiloid type of body illustrated by *Lycopodium Selago* and its allies (the author's well-known "theory of the strobilus"). This reconstruction of the most primitive vascular body is obtained by converging all the known pteridophyte lines, and the result is a body which arose from no one knows what, but which does not suggest any known bryophyte or alga.

This is a very meager outline of the contents of a large volume, crowded with facts and suggestions. Such speculation brings perspective and stimulus, and its only danger is a confusion of theory with fact, for which the author in this case could not be held responsible. Perhaps the most serious charge that could be brought against him, in this connection, is his great command of picturesque statements, which are highly figurative but contain perilous suggestions for the unwary. For example, that "encouragement was given" to a multiplication of spores; that the method of fertilization in archegoniates is "awkward and embarrassing;" that "a premium was put upon" aerial spores, etc., are extremely telling forms of statement, but they are more rhetorical than exact, suggesting far more than was intended.

At all events, the volume is a monument to the research power and philosophical insight of its distinguished author.—J. M. C.

Electro-physiology

Two years ago plant physiologists were rather taken aback by a large volume of researches on plant response from the pen of a contributor previously unknown in this field. It is not often that so brilliant a display marks the advent of a new scientific luminary, and it was impossible at once to determine whether he was a meteor, whose light would flash and disappear, or a star of the first magnitude. There were not wanting, indeed, signs that he was erratic. This work² conspicuously lacked relation to the present state of knowledge and showed scant acquaint-

² BOSE, J. C., Plant response as a means of physiological investigation. See review in BOTANICAL GAZETTE 42:148. 1906.